

DOE Transmission Reliability Program

Peer Review

Spinning Reserve Demonstration Project

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May 20-21, 2002
Washington, D.C.



Spinning Reserve from Water Pumping Load

- Spinning reserve has traditionally been provided by generating capacity.
- The project would consist of controlling water pumps so that they could provide spinning reserve by reducing load.
- The project also provides a soft start for these pumps to eliminate motor degradation from starting.



Goals

- The project would provide flexibility in operations, and free up generation used to supply spinning reserve.
- An idea whose time has come, loads presently supply other types of reserve such as supplementary reserve.
- NERC has indicated that they would be receptive to a waiver request.
- We will work with NERC, WSCC and the CAISO.



Additional Revenue to CDWR

- Let us make the following assumptions for purposes of discussion:
 - We can supply spin from 10% of the 139 pumping units in the DWR, or 14 pumps.
 - The 14 pumps are rated at 10,000 Hp.
 - We can supply spin for 10 hours per day, 250 days per year.
 - The average price is \$7.32
- The annual revenue that could be obtained then may be roughly estimated as:
- $14 \times [10,000 \times (.746 / .95)] \times 10 \times 250 \times 7.32 \cong \2 Million



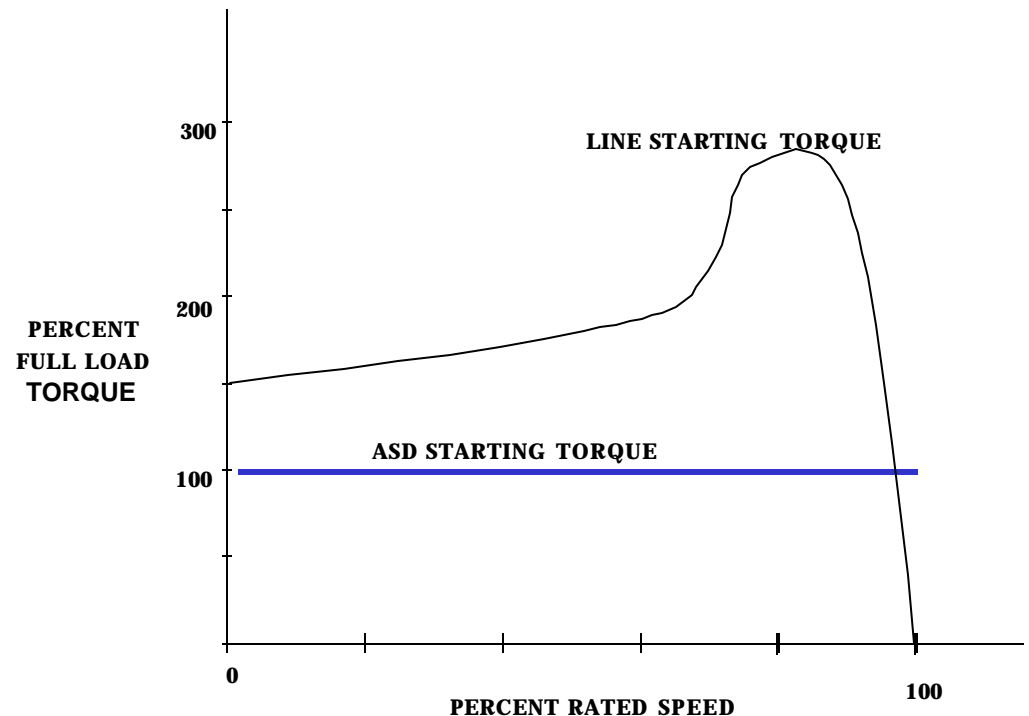
Potential Spin Addition

- 140,000 Hp is 104 MW.
- The coincidental load in California ranges from 20 to 35 GW.
- The spin requirement is roughly 4% of this, or 800 to 1,400 MW.
- The 104 MW could represent roughly 10 to 15% of the total spin requirement.



Other Benefits

- We would provide a soft start for the large pump motors and thereby extend motor lifetimes.
- The spin resource would be provided where it is needed, near the load.
- We would “free up” 100 MW of generation to generate power.
- This will alleviate congestion on the transmission lines.

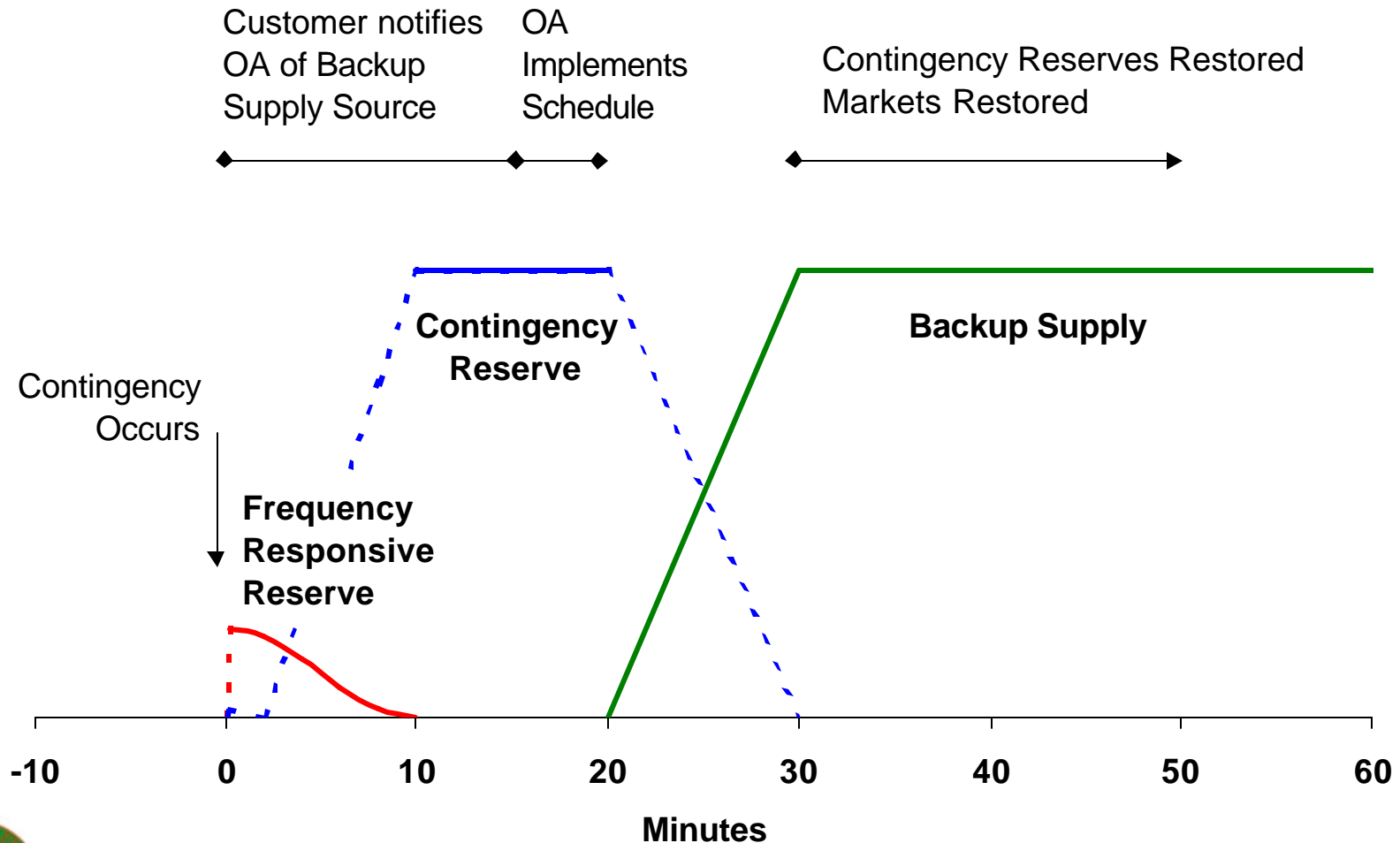


The Variable Speed Drive
Can Support Soft Startups



Response Time Defines Contingency

Response Requirements



Activities

- A determination would be made as to which pumps could be stopped, and when, that is, what hours of the day.
- Sophisticated SCADA is already installed, and the additional control cost would be low.
- The cost for the soft start would be low because we will not be powering the motor under load, only during the start.



How Fast Would the Pump Stop Have to Be?

- The stop would have to be started in ten seconds and completed in ten minutes.
- The pumps would have to be kept in the stop condition for up to two hours.

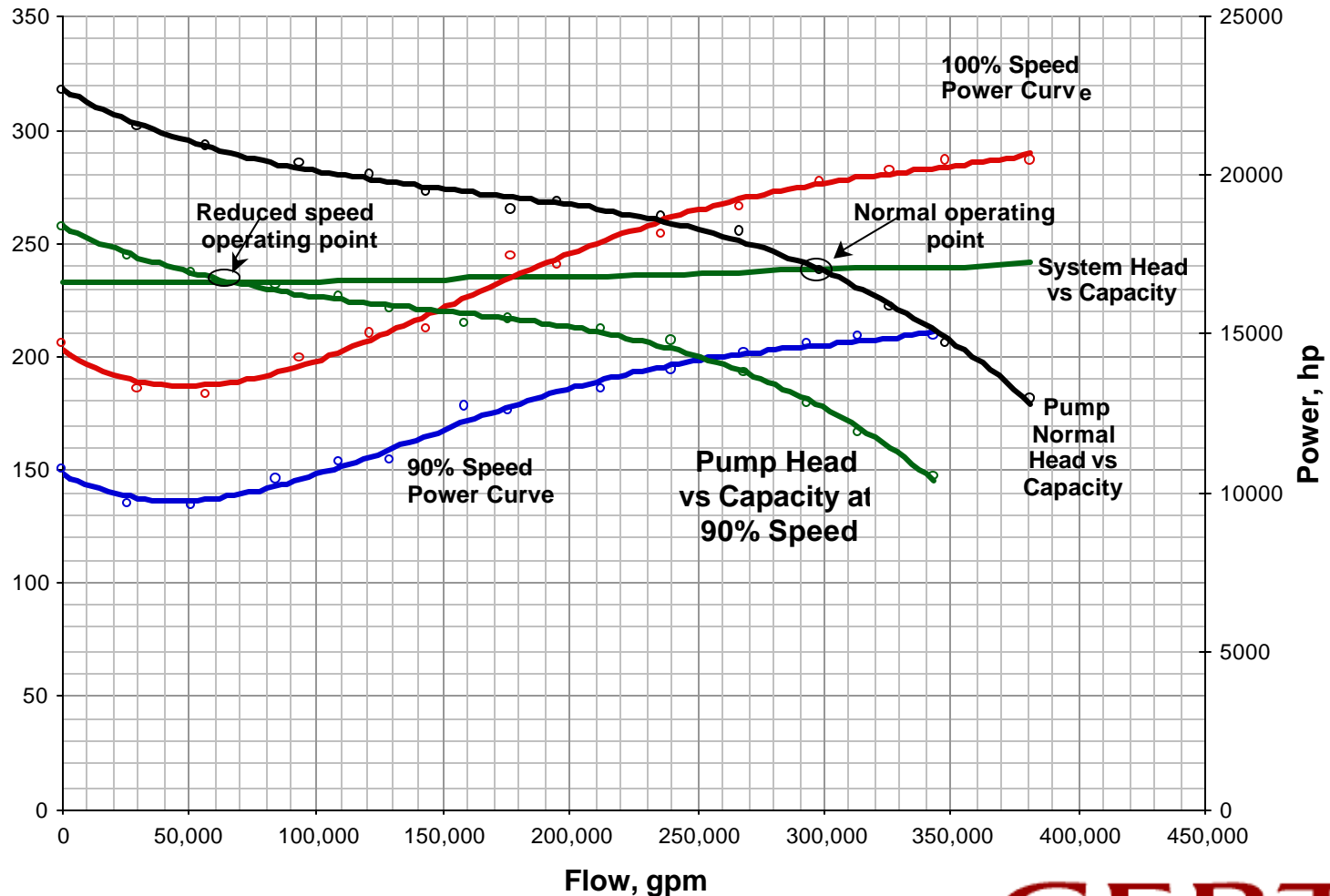


We Will Not be Using a Speed Runback

- The static head is 97% of the total head in the pump suggested by the CDWR.
- Reducing pump speed will not result in dramatic reductions in power and flow, as in a friction dominated system.
- The pump would be operating in an extremely inefficient condition.



Operating Point with Reduced Speed: Minimal Advantage



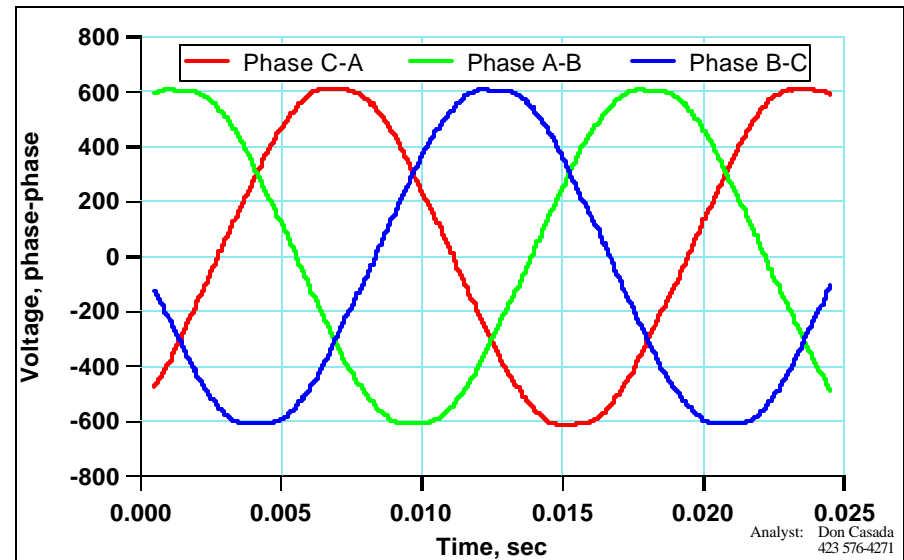
Soft Start for Pump Motors

- As an alternative to controlling speed, it may be possible to simply start and stop the pump motors.
- The pumps and motors have a combined inertia of about 1.2 million pound feet squared.
- The motors bring this inertia to synchronous speed in 2 seconds.
- The pump start process now takes 4 to 5 minutes, and still causes significant motor wear.



Proposed Idea

- Use a conventional variable frequency drive to start the motor with the discharge valve closed.
- The VFD will take about two minutes to accelerate the motor, and perhaps only 500 Hp.
- When the motor has reached synchronous speed, disconnect the drive, and connect the rated line voltage.
- Proceed with the pump start process as normal.
- This modification would be inexpensive.
- The water purge may also be eliminated.



The VFD creates a three-phase voltage waveform with a variable frequency and magnitude.



Proposed Steps

- ORNL will review the proposed project with the CDWR.
Jun 02
- ORNL would sign a non-disclosure agreement with the California Department of Water so that ORNL could review the present pump operation methodology to make an initial assessment of the savings potential. Sept 02
- ORNL, together with Ferraro, Oliver and associates, would prepare an estimate and preliminary design for the soft starter.
Dec 02



Proposed Steps, Contd.

- ORNL would prepare a plan for the pumps, time frames, MW amounts, etc. that would be proposed. Mar 03
- Using the plan as a basis, ORNL would prepare a waiver request for WSCC and NERC. Jun 03
- ORNL would arrange for a preliminary engineering study of the needed controls, adjustable speed drives, cost and schedule for the demonstration, including estimates of the funding needed and payback. Dec 03



Proposed Steps, Contd.

- Based on the findings of the report from the above studies, funding would be obtained to implement the modification. May 04
- ORNL would follow and provide guidance during the implementation, and a technical paper will be prepared following completion, authored by the CDWR and ORNL. Dec 05



What Are the Benefits?

- Generation that is presently being used to supply spinning reserve could be used for power sales.
- Reducing local load will have a much greater impact in addressing contingencies than supplying an equal amount of generation.
- There would be greater flexibility in CDWR system operation, and a new revenue source would be provided.
- Motor lifetimes would be increased due to the soft start.
- The practice would be implemented across the nation.



Accomplishments

- A review of existing pumping hydraulics has been performed.
- Discussions have been held with CDWR to review the potential for spin and to select candidate pumps.
- Preliminary analysis shows that a soft start could be installed for a relatively low cost.
- The soft start would provide additional benefits in addition to providing spin.
- A meeting has been scheduled with the CDWR to discuss the concept.

